UNIT D

Safety in Transportation

While you are driving on a secondary highway, you glance into your rearview mirror. A 16-wheel transport truck has come up behind you and intends to pass.

You are driving at the posted speed limit. It would not be safe to pull off to the side at this point in the road.

You take another look in your rearview mirror to see if the truck has backed off. While you are checking, a white-tailed deer moves onto the road in front of you! There is no time to stop.

If you were the driver, what would you do in the situation described above? How could either you or the driver of the transport truck have prevented the situation?

In this unit you will explore speed and momentum. A knowledge of these will help you understand what happens during collisions. You will also learn how various safety features

- reduce the chances of having a collision, and
- protect drivers and passengers during collisions and sudden stops.

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A Need for Safety

Chapter 14
The Nature of Speed

Chapter 15
The Physics of Collisions

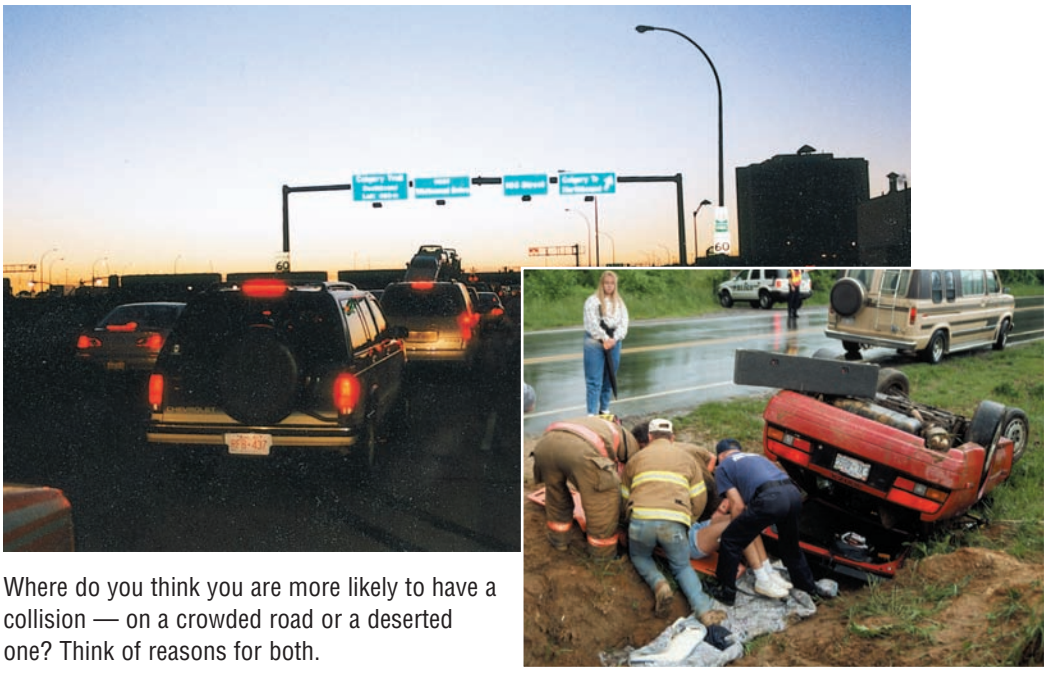
Chapter 16
The Technology of Safety

CHAPTER 13

A Need for Safety

Getting Ready...

- What gender and age groups tend to have the most motor vehicle collisions?
- What are the physical, emotional, and legal consequences of a motor vehicle collision?
- How do alcohol and other chemicals affect one's ability to drive safely?



Where do you think you are more likely to have a collision — on a crowded road or a deserted one? Think of reasons for both.

Science Log

Write about a collision you have been in, narrowly avoided, or seen. How did it happen? Who was at fault? Could it have been prevented? Were the weather conditions or the road design a factor? Was either driver distracted, drunk, or sleepy?

It is 8:30. You were supposed to be at the party at 8:00. The light turns green and you press on the accelerator as you see the cars in front of you start to move. You don't like the song that is playing, so you lean over to change the …

CRASH!

While your attention was on your CD player, the cars ahead of you stopped to let an animal cross the road. You have just caused a rear-end collision.

How can you avoid such collisions? You might start by learning about the most common driver errors that cause collisions. By avoiding these, you lessen your chances of having one.

In this chapter you will learn about common driver errors. In addition, you will examine transportation data and studies to try to learn where Canadian traffic problems are, and how to make our roads and drivers safer.

You will also work through scenarios to answer question such as:

- What factors lead to traffic accidents?
- Is there a connection between reaction time and motor vehicle collisions?
- What are the most common injuries resulting from collisions?
- How are vehicles and roads designed to keep drivers safe?

There are many reasons for driving safely.

What You Will Learn

In this chapter you will learn:

- that most collisions are preventable and due to driver error
- that use of alcohol or medications, distractions, and fatigue are often factors in vehicle collisions
- about the common types of injuries caused by vehicle collisions
- what accident victims do to heal after vehicle collisions
- about the different regulations and road features that protect drivers

Why It Is Important

- Motor vehicle collisions injure or kill thousands of people every year. By learning about the most common driver errors, you can develop safer traffic habits. These might save your life — or someone else's.

Skills You Will Use

In this chapter you will:

- analyze data involving collisions
- consider how alcohol, medications, and fatigue affect reaction time
- interview a professional who deals with collision injuries
- investigate the effectiveness of vehicle safety features and regulations

Starting Point ACTIVITY

Crash Statistics

What to Do

1. This table shows the number of collisions, injuries, and fatalities (deaths) for the years 1995 to 1999. Create a bar graph showing each category of information.
2. Use the graphs to help you answer the questions that follow.

What Did You Discover?

1. Overall, are the following increasing or decreasing?
   - total collisions
   - total injuries
   - total deaths
2. Between 1997 and 1998, collisions rise as do injuries, but fatalities stay the same. Offer an explanation for this relationship.
3. With a partner or small group, discuss and list at least three reasons why the annual number of injuries due to collisions seems to be increasing.
4. How many people do you know who have a driver's licence? How many of these people have been involved in a collision?

Table 13.1 Alberta Traffic Collisions 1995–1999

	1995	1996	1997	1998	1999
total collisions	85 220	93 832	92 365	98 601	95 246
number killed	403	349	429	429	347
number injured	20 866	22 268	23 916	24 935	25 451
licensed Alberta drivers (thousands)	1970	1999	2020	2072	2127

5. Give one reason for the rise in collisions between 1995 and 1999.

13.1 Analyzing the Danger

READING Check

Explain how likely you are to die in a traffic accident than from other causes.

An automobile collision is much more serious than falling off a bicycle or down the stairs. The injuries from vehicle collisions range from scratches and bruising to serious internal damage causing death. Many injuries are severe and long-lasting. Victims may break bones, suffer burns, or receive brain damage.

Think it will happen to everyone but you?

Figure 13.1 Collisions result in more than financial loss. Survivors of crashes may have severe injuries.

Think again. You are 50 times more likely to die in a road collision than you are to die in an airplane mishap.

Do you ever worry about getting murdered? In Canada, you are five times more likely to die in a traffic accident than to be murdered. Your chances of being injured in an automobile accident are dozens of times greater than that.

The sad thing about these high numbers is that almost all vehicle collisions are preventable! Nearly all of the injuries and deaths that occur on Canada's roads each year need not have happened.

In the Starting Point activity on page 233, you learned how common traffic injuries and fatalities are in Alberta. In this section you will learn about the chances of dying on the roads compared to dying of other causes. You will also consider which modes of transportation are the most dangerous.

Find Out ACTIVITY

What Are the Most Common Causes of Death?

This table provides **statistics** about Canadians who died during the period from 1993 to 1997. Statistics are numerical facts about people, transportation, diseases, and other items that are gathered and analyzed in an effort to help people improve their life by avoiding accidents or reducing their chances of getting a disease. Statistics can be used to learn about why problems happen. These statistics show the number of people who died of each cause per 100 000 of population.

SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

Table 1 Percentage of Driver Injuries and Fatalities, by Age Group (2000)

Age Group	Serious Injuries	Fatalities	Number of Licensed Drivers (thousands)
15–19	11.0	9.8	1088
20–24	15.5	13.3	1693
25–34	20.7	18.6	3875
35–44	19.7	17.9	4896
45–54	15.0	15.8	4067
55–64	7.7	9.3	2470
65+	9.4	14.8	2497
Totals*	99.0	99.5	

* This table does not add up to 100 because some ages were not stated and some accidents were caused by under-age drivers.

Table 2 Canadian Causes of Death

Cause	1993	1994	1995	1996	1997
cancer	310	311	306	306	297
diabetes	17	17	18	17	17
heart and blood system diseases	252	243	238	233	225
respiratory diseases	61	60	60	60	60
chronic liver diseases	8	7	7	7	6
infant death and fatal birth defects	8	8	8	8	8
injuries and poisonings	67	64	65	63	60
motor vehicle accidents	13	11	11	11	10
suicide	13	13	14	13	12
homicide	2	2	2	2	2
other causes	112	114	116	114	120

*per 100 000 of population

What to Do

1. Study the tables and answer the questions that follow.

What Did You Find Out?

1. (a) Using the information from Table 1, compare the number of drivers to the number of fatalities and injuries for each age group. What age of driver appears to have the highest and lowest percentage of serious injuries? of fatalities?

(b) Suggest reasons for each.

2. (a) Use two bar graphs to plot the data for Table 1.
- On the first graph, plot the data about serious injuries and fatalities according to age group. Use different colours of bars for each age group.
- On the second graph, plot the number of licensed drivers by age group.

(b) Using *only* this information, what group of drivers should have the highest and lowest insurance rates?

3. From Table 2, list, in order, the four most common causes of death for Canadians.

4. On Table 2, which causes of death appear to be decreasing overall? Give a possible reason for each decrease.

5. (a) Which causes of death can you take action to prevent?
(b) List some prevention strategies for each of these.

6. Table 2 statistics represent people of all ages.
(a) Which causes of death would likely be more common for elderly people?
(b) Which causes of death would likely be more common among teenagers?

Injuries

Each year, more than 200 000 Canadians are injured in motor vehicle crashes. Their injuries include:

- cuts, bruises, and broken bones;
- whiplash;
- serious burns;
- internal injuries; and
- head and spinal injuries that may lead to blindness, paralysis, or brain damage.

Each of these injuries has a cost in pain and suffering. Most could have been prevented.

You will learn more about some of these injuries later in this chapter. As well, you will interview a health professional to learn how some injuries are treated and could be prevented.

DidYouKnow?

More vehicle collisions happen on Friday than on any other day of the week.

READING Check

List four types of injuries that could result from vehicle accidents.

INVESTIGATION 13–A

SKILL CHECK
- Initiating and Planning
- Performing and Recording
- ☼ Analyzing and Interpreting
- Communication and Teamwork

How Safe Are You?

Think About It

How did you get to school — on foot? by bicycle or motorized vehicle?

How safe is the method of transportation you used? Which vehicles are the least safe?

Analyze the statistics in this exercise to find out.

What to Do

1. Analyze the table of statistics provided by your teacher. Study each table and then answer the questions that follow.
2. Draw three bar graphs to help you interpret the data in each table.

This person's life-threatening injuries could have been prevented.

Analyze

1. Study the graph that you created for Table B. What kind of vehicle has the most accidents? Why do you think this is so?
2. Suggest two reasons why more than twice as many motorcyclists have died compared to bicyclists.
3. Suggest why twice as many drivers as passengers have died.
4. Which mode of travel accounts for the largest percentage of transportation fatalities?

Extend Your Knowledge

5. The statistics show that fewer people have died in all-terrain vehicle accidents than in motorcycle and truck accidents. Does this mean that all-terrain vehicles are safer than motorcycles and trucks? Explain your answer.

Key Terms

statistics

Check Your Understanding

1. Identify common injuries you might get in a motor vehicle collision.
2. List five specific factors that affect safety on Canada's roads. For example, what specific driver errors and road conditions or features can cause or prevent motor vehicle collisions?
3. How safe is road travel compared to travel by other methods of transportation? Explain your answer.
4. In Canada, how likely are you to die in a vehicle crash, compared to dying by another cause?

13.2 Reaction Time

The time it takes you to recognize a problem and act on it is called **reaction time**. In the chapter opener, you were unable to stop because you had not been paying attention. Let's rewind the situation from the chapter opener. Pretend that you did not lean down to adjust the radio station or CD player. Could you have stopped in time?

Even if you are alert and react very quickly, there are many factors that affect a driver's ability to stop. The road may have been icy. Your car might have had bald tires or poor brakes. As a result, you might have slid into the car in front of you even though you had been paying attention.

Some drivers have a habit of following too closely. These drivers do not always have enough room to stop if the car in front stops suddenly. Look at figure 13.2. What could happen to the second car if one of the horses bolts and runs across the road in front of the first car? What else might happen?

Figure 13.2 What suggestions do you have for these drivers?

READING Check

What is reaction time?
Why is it important to drivers?

Reaction Time and Distractions

Anything that takes your attention away from what you are supposed to be doing is called a **distraction**. You cannot really stop distractions from occurring outside your car. However, you can control the distractions *inside* your vehicle.

Are cellular phones really a problem? Statistics suggest they are. Dialling or having a conversation on a cellular phone can slow reaction time. During some conversations, reaction time can be slowed by up to three times. For example, a driver who usually reacts in two seconds may take six seconds to react. This is why many people think it should be against the law for drivers to use a cellular phone while driving.

READING Check

Explain how distractions might slow reaction time.

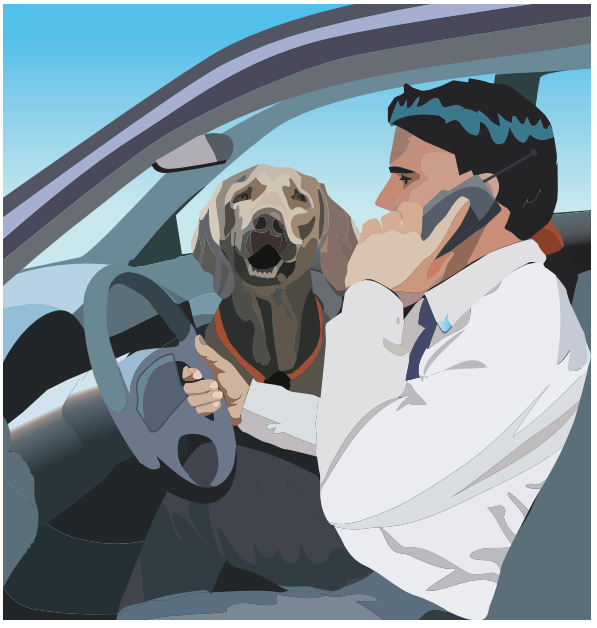


Figure 13.3 Your attention cannot be split between driving and other tasks without creating a danger. Having conversations or tending to children or pets while driving can be very distracting. What traffic law(s) relate to driving distractions?

CONDUCT AN

INVESTIGATION 13–B

SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

Think Fast!

Collisions occur when drivers react too slowly. Reaction time while driving is slowed down when drivers are tired or distracted. Conduct this investigation to see how these factors — and others — slow *your* reaction time.

In the following activity, you will work with a partner to test your normal reaction time. Then you will simulate distractions, fatigue, and dizziness, and test your reaction time under these influences. In this investigation, the difference is measured when you are catching a ruler. In traffic, a slow reaction time might mean the difference between life and death — yours or someone else's.

Problem

How do distractions, fatigue, dialling a cell phone, and dizziness affect your ability to react to something you see?

Prediction

1. How many centimetres of the ruler do you think will pass through your fingers before you stop it?

2. How much will distraction, fatigue, and dizziness affect your reaction time? Make a prediction in centimetres for each factor.

Safety Precautions

- Be very careful when spinning around to perform the trials that require dizziness. Make sure the area used for spinning is free of sharp corners on objects (such as desks).

Apparatus

metre stick

Procedure

1. Read through the procedure, and then develop a table for recording your results during the investigation.

Part 1: Reaction Time

2. One partner sits at a desk with one forearm placed flat on the desk and that hand extending over the edge. The thumb and forefinger of the hand should be about 3 cm apart.

3. The other partner holds a metre stick with the bottom end hanging between the thumb and forefinger of the seated person.

4. The partner holding the metre stick should drop it without warning. The seated partner must grab the metre stick between the thumb and forefinger.

5. Check and record the number of centimetres the metre stick drops before being caught.

6. Repeat Steps 4 and 5 three times. Hold the metre stick in the exact same position at the start of each trial.

7. Switch roles and repeat Steps 2 through 6.

Part 2: Reaction Time with Distractions

10. Repeat Steps 2 through 7 again. This time, the seated partner starts with the number 1, and adds 3 to it continually (that is, $1 + 3 = 4$, $4 + 3 = 7$, $7 + 3 = \ldots$).

10. Repeat Steps 2 through 7 again. This time, the seated partner starts with 1, and adds 2 to it, then adds 3 to that answer, then adds 4 to that answer, and so on (that is, $1 + 2 = 3$, $3 + 3 = 6$, $6 + 4 = 10$, $10 + 5 = \ldots$).

10. Repeat Steps 2 through 7 again. For this series, the seated partner starts with 1 and multiplies by 2 continuously (that is, $1 \times 2 = 2$, $2 \times 2 = 4$, $4 \times 2 = 8$, $8 \times 2 = \ldots$).

Part 3: Reaction Time while Dialling

11. For these trials, the seated partner must dial a given phone number (without pressing the send button). The partner should continue to dial until the metre stick is dropped.

Part 4: Reaction Time with Dizziness

12. For these trials, the seated partner should be dizzy. Spin on a swivel chair or spin on the spot until you are dizzy and then sit down. Then, repeat Steps 2 through 7 twice more, with no distractions.

Internet CONNECT

www.mcgrawhill.ca/links/science.connect2

To get a more accurate idea of your reaction time while driving, go to the above web site, then to Internet Connects, Unit D, Chapter 13, and then to Reaction Time.

Analyze

1. **(a)** Calculate your average score for the trials in each part of this investigation.

   (b) Did your results improve from the first to the last trial for each part? If so, why?

2. **(a)** How did your scores for reaction time with distractions compare to your base reaction time?

   (b) Did the complexity of the math affect your reaction time? Explain.

   (c) How does this relate to distractions on the road or in your car?

3. Did dialling a phone affect your reaction time? If so, by how much?

4. **(a)** Did dizziness affect your reaction time? If so, by how much?

   (b) What driver problem might this suggest?

Conclude and Apply

5. What are some distractions that may slow your reaction time while driving? How can you control or eliminate these distractions?

Extend Your Knowledge

6. Draw a large diagram of a traffic situation. Use paper cutout cars to show your classmates how an alert driver might be able to react in time in a certain scenario, but a drunk, distracted, or tired driver might crash. In your scenario, could the paper car drivers have prevented the collision?

7. Did your results confirm your hypothesis? Explain.

Figure 13.4 Driving when you are tired can be deadly because fatigue slows reaction time. If you find yourself yawning or blinking, pull over in a safe place and have a nap.

Fatigue and Reaction Time

Fifteen percent of drivers surveyed said they have actually fallen asleep while driving! Sleepy drivers are a serious danger to themselves and others because they cannot pay enough attention to the road and traffic demands. Like drunk drivers, they may

- run off the road;
- roll their vehicle into a ditch; or
- cross the centre line and drive into oncoming traffic, possibly killing other people and themselves.

Some people think they can drink coffee to stay awake, because coffee contains caffeine, which is a **stimulant**. Stimulants increase heart rate and speed up reaction time. However, when the effects wear off, the user is more tired than before — and therefore has a slower reaction time.

No amount of caffeine, loud music, cold air, or pinching yourself will keep you awake. Sleep is the only cure. Pull over to a safe parking place and take a nap.

READING Check

How well does coffee work to speed up reaction time?

Reaction Time and Drugs

This morning, you woke up feeling sick, so you took a cold remedy before coming to school. Your nose is not running any more, but your head feels woozy. Believe it or not, you are **impaired**. This means you are unable to function normally. Alcohol, prescription drugs, and non-prescription drugs can affect the human body in ways that make it dangerous for a user to drive.

READING Check

Explain why alcohol slows reaction time.

Alcohol is absorbed from the stomach and the small intestine directly into the bloodstream. The human body recognizes alcohol as a poison. The liver produces enzymes that change it into other, safer chemicals. However, once someone has consumed one drink, there is too much alcohol for the liver to deal with all of it at once. The alcohol will move through the blood and have toxic effects.

Figure 13.5 May cause collisions!

Alcohol is a **depressant**. This means that it slows reactions, lowers co-ordination, and makes the drinker sleepy when it reaches the brain tissue.

Off the Wall

Statistics show that many teenagers die while driving at night and with their friends in the car. For this reason, many provinces now have a multi-step driver's licence policy. First you get your learner's licence — you can drive only when you have another, experienced driver in the car with you. Second, you get a licence that allows you to drive under certain restrictions. For example, you might be allowed to drive only during the day or with a certain number of passengers.

In provinces where this graduated licencing system is used, inexperienced drivers have been getting into fewer accidents.

Blood Alcohol Concentration

How do people know whether or not they have had too much alcohol and should not drive? Courts can use a **BAC** (blood alcohol concentration) reading. BAC refers to the number of milligrams of alcohol in a millilitre of blood. If a person's BAC is 0.08, this means that there are 0.08 mg of alcohol in each mL of the person's blood.

Each individual's BAC depends on the number of drinks consumed and body weight. One **drink** is defined as 45 mL of hard liquor (40%), 150 mL of wine (11%), or 350 mL of beer (4%).

How much any individual can drink depends on body weight. Two drinks, one after the other, will put anyone weighing 45 kg or less over the legal limit. A person who weighs 110 kg may be able to have four or five drinks, one after the other, before reaching the legal limit.

BAC does not take into account the amount of food or sleep that a person has had, or the rate at which a person drinks. Generally, having one drink per hour at a party is considered safe for driving. But someone who is tired or hungry can become impaired much more quickly.

BAC also does not take years of drinking experience into account. An older, heavy drinker may have a BAC of 0.8 (10 times higher than the legal limit) and not show any signs of impairment. A younger or smaller person can often have a BAC well below the legal limit and be too impaired to drive safely.

The Math Connect on page 242 will help you calculate how long you should wait before you drive after drinking.

DidYouKnow?

In 1999, 23 percent of all drivers involved in fatal crashes in Alberta had consumed alcohol before the crash.

Figure 13.6 Police measure BAC using a breathalyzer. The law in many provinces says that people with a BAC of 0.08 or over are too impaired to drive.

READING Check

Explain what BAC means and why it is important.

Figure 13.7 Devices like this provide pass, fail, or warning readings of blood alcohol content. Some are sensitive enough to detect the alcohol on your breath from using mouthwash.

READING Check

What is the legal blood alcohol content for driving in Canada? Why?

Blood Alcohol and the Law

What does the law say about drinking and driving? In Canada, a BAC level of 0.08 is generally considered the legal limit. However, a police officer can charge drivers who have *any* alcohol on their breath when they are pulled over. The charge is **impaired driving**.

Drivers are considered to be impaired when their reactions are slower than normal. This includes slurred or slow speech and being unable to walk in a straight line.

DidYouKnow?

Many bars now offer devices that test BAC, so that drinkers can test their alcohol levels before they walk out the door. A BAC level is not the only or the best measure of impairment. People who feel dizzy, giggly, wobbly, or at all unsure of their abilities, should not drive. It is better for such people to stay where they are, and start drinking water or soft drinks instead of alcohol. Many bars also provide free non-alcoholic drinks to designated drivers.

Math CONNECT

How Soon Can a Drinker Drive?

BAC reports the number of milligrams of alcohol present in 100 mL of blood. Generally, the human body can eliminate alcohol at a rate of 0.015 mg/mL every hour.

Sample Problem

A male who weighs 70 kg and has four quick drinks at a party will have a BAC of about 0.115. If the alcohol leaves the body at a rate of 0.015 BAC units per hour, how many hours will it take until this person is legally able to drive?

Steps in Solving It

1. *What do you know?*
   BAC rate is 0.115
   Alcohol leaves body at 0.015 BAC units per hour
   Legal BAC limit is 0.08
2. *What do you want to find out?*
   How long will it take for the drinker to be able to drive legally?
3. *How far over the legal limit is the drinker?*
   To find out, subtract the legal limit from the BAC rating.

$$\begin{array}{r} 0.115 \text{ BAC} \\ -\ 0.080 \text{ BAC} \\ \hline 0.035 \text{ BAC} \end{array}$$

   The drinker's BAC is 0.035 units over the limit.
4. *How long will it take this drinker to get down to the legal limit?*
   The body gets rid of 0.015 BAC units per hour. You need to calculate the number of 0.015 units there are in 0.035.

$$\frac{0.035 \text{ BAC}}{0.015 \text{ BAC/h}} = 2.33\text{h}$$

If this drinker does not have anything else to drink, it will take slightly longer than 2.3 hours before the person can legally drive.

Solve These

Use the example above to help you solve the following problems. Be sure to show all of your calculations.

1. A 50 kg female who has two drinks will have a BAC level of 0.09. How long will it be until she will be able to drive?
2. Joby drank some whisky with his friends after winning a football game. He weighs 100 kg. His BAC level was 0.117 after six drinks. How many hours must he wait before legally being able to drive?

Key Terms

- reaction time
- distraction
- stimulant
- impaired
- depressant
- BAC
- drink
- impaired driving

Check Your Understanding

1. Name four things that would increase your reaction time.
2. Alcohol is a depressant. How do depressants affect the human body and reaction time?
3. Why do people drink stimulants like caffeine while driving? How effective is this strategy?
4. Name two reasons why talking on a cellular phone while driving is a dangerous practice.
5. **(a)** Can alcohol cause impairment before a person is over the legal limit?
   (b) Can someone who is under the legal limit for BAC be arrested for impaired driving? Explain.
6. Is talking to a passenger or drinking a soda while driving a wise practice? Explain your reasoning.

13.3 Collision Injuries

Figure 13.8 Collisions result in more than financial loss. People may spend years trying to walk again after a serious accident.

Collisions cause damage to more than cars. People involved in a rear-end accident like the one described in the chapter opener may have serious physical injuries. Some may also have emotional problems as a result of the accident.

The physical and emotional stress that results from an accident is referred to as **trauma**. Physical trauma can range from cuts and scrapes to more serious and lasting injuries like broken bones, whiplash, and brain damage.

Some of these injuries heal on their own, while others do not. Physical therapy or Chiropratic care may help to correct some damage. Some injuries cannot be repaired. These include injuries that involve major brain damage, require amputation, or involve the spinal cord.

Physical traumas are often visible. Emotional traumas are not. Some people may feel fearful of all driving after an accident. Others experience emotional trauma associated with grief or regret after an automobile collision that caused serious injury or death. Emotional counselling can assist people with such trauma.

READING Check

What is trauma? Give three examples.

Whiplash

Whiplash occurs when the muscles and ligaments of a person's neck are sprained. It is a common injury for the people in the front car of a rear-end collision.

Seat belts keep most of the body restrained. Properly adjusted headrests prevent the head from flying backward beyond the back of the seat. If the headrests are not adjusted, however, the head may fly forward and then backward during a collision. Since heads have a mass of about 4.5 kg, this movement can over-stretch the neck muscles.

Whiplash is treated in a variety of ways. Chiropractic or massage therapy can be helpful. Some patients wear a neck brace for support while the muscles and ligaments heal.

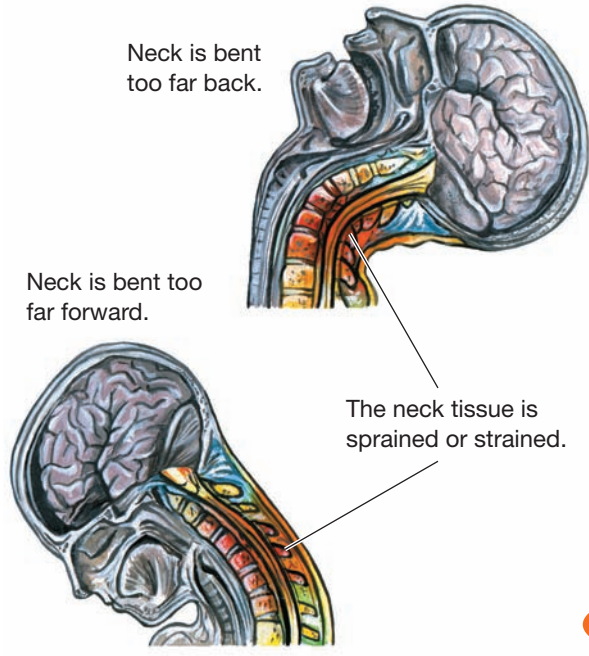


Figure 13.9 Whiplash occurs when the muscles and ligaments of the neck are stretched too far or compressed too much.

READING Check

How does a headrest help prevent whiplash? Draw a diagram to show how it might help.

Grief

How would you feel if you were driving carelessly and got into a serious accident? How would you feel if your passengers died? How would you feel if you survived, but all the people in the other car were killed?

It can take a long time to get over the feelings of regret and sadness we call **grief**. Sometimes, people feel unable to talk about their feelings, or do not allow themselves a long enough adjustment time to get used to their grief. Talking to a professional who understands sadness helps many people deal with this type of emotional pain.

Find Out ACTIVITY

What Happens after an Accident?

Many people deal with accident victims, both at the scene of the accident and afterwards. These include:

- police officers and Emergency Medical Technicians (EMTs) who attend the accident itself;
- physiotherapists, chiropractors, and occupational therapists who deal with physical traumas;
- psychotherapists, who help people get over emotional traumas, such as the painful feelings associated with an accident, injuries, or death; and
- members of community groups such as MADD (Mothers Against Drunk Driving) and SADD (Students Against Drunk Driving).

Once the major injuries have been dealt with, these people provide encouragement and therapy that helps the patient return to a normal life. **Therapy** is any kind of treatment that does not require surgery or drugs.

In this activity, you will interview someone who works with accident victims.

SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

What to Do

1. As a class, choose a profession or organization you would like to learn more about by conducting a class interview.
2. Brainstorm questions to ask.
3. Identify and invite a specific person.
4. Take notes during the class interview.

What Did You Find Out?

1. What types of trauma do those involved in motor vehicle collision experience? What role does therapy play in the healing process?

Internet CONNECT

www.mcgrawhill.ca/links/science.connect2

Find out more about a career as an Emergency Medical Technician by going to the above web site, then to Internet Connects, Unit D, Chapter 13, and then to EMT. What does it take to get into this work? How do EMTs assist victims of an accident?

Key Terms

trauma
whiplash
grief
therapy

Check Your Understanding

1. Name two types of trauma. Explain how each type of trauma is treated.
2. Name two types of injuries that can be healed. Name two types of injuries that cannot be healed.

13.4 Protection and Prevention

Safety features are built into vehicles and roads to protect you in case of a road accident. As well, there are laws concerning proper driving procedures and commercial campaigns designed to make us aware of specific traffic dangers.

Safe Vehicles

In Alberta, the law says that every person in a car must wear a seat belt. Small children and babies must be restrained using specially designed seats. Does this law keep you safe?

The statistics say yes. In 1999, people who did not wear seat belts were three times as likely to be injured as those who did wear them.

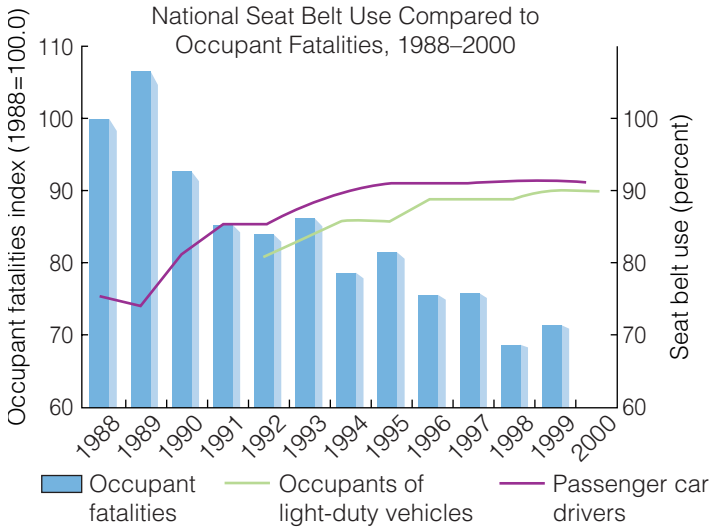


Figure 13.10 What has happened to the number of fatalities since seat belt laws were passed in 1987?

Seat belts work constantly to restrain passengers. Other safety features are designed to work only when a collision happens.

- Air bags inflate when a collision occurs. They cushion drivers and passengers against impact.
- Anti-lock braking systems (ABS) provide better stopping ability in slippery conditions.
- Crumple zones are on the outer parts of the car, near the bumpers. When these zones crumple, they take the energy of the collision so the passengers feel less effect.
- Side impact beams are steel beams in the doors. They prevent the doors from caving in. This protects the people inside the vehicle.

DidYouKnow?

The emergency brake can be used to stop a vehicle if the regular brakes fail. Emergency brakes work on a cable system, so will work even when the regular brakes do not.

Vehicle Maintenance

Seat belts, air bags, and brakes protect you only when they are working. **Maintenance** or continual care makes sure they continue to do so. Regular maintenance is important for all safety features on your vehicle. These include:

- tires — Worn tires, with little or no tread, skid easily. This affects the time it takes for your vehicle to stop.
- steering — Taking care of the steering mechanism and all the parts connected to it ensures you can move the car where you want, when you need to.
- windshield wipers — These keep your windshield clear so you can see the road ahead. This allows you to identify possible emergencies and increase your chances of stopping when needed.

READING Check

List the features in modern vehicles that either work to prevent accidents or protect the driver and passenger during an accident. Explain why each should be maintained.

DESIGN & DO

INVESTIGATION 13-C

SKILL CHECK

- Initiating and Planning
- Performing and Recording
- Analyzing and Interpreting
- Communication and Teamwork

Driving with Restraint

How effective are seat belts in preventing injury during a collision? Can a more effective seat belt be designed than the one that is now standard in family vehicles?

Challenge

Design and build an effective seat belt to protect a clay person in a dynamics cart.

Safety Precautions

- Make sure no-one is in the way when you roll the cart down the ramp and into the collision barrier.
- Clean up the work area and wash your hands thoroughly at the end of the investigation.

Apparatus

dynamics cart
wooden blocks
wooden boards
scissors

Materials

chalk
rubber tubing (about 1 cm in diameter)
rubber bands
small balloons
modelling clay

Design Criteria

A. Design and build a ramp. This will be the run for the dynamics cart.

B. Decide what type of collision will occur, and how you will produce the same collision for each trial.

C. Make a human figure out of modelling clay. Make the body human-like but smooth, so you can clearly see the injuries that occur.

D. Design and build a safety restraint to protect the clay figure from impact.

Plan and Construct

1. In your group, decide how you will set up your ramp and make your clay person. Make sure the clay person is re-formed to the exact same shape at the start of each trial run.
2. Decide how each trial run will be done, and how many trials you will do for each design.
3. Design several different seat belt set-ups.
4. Develop a procedure for checking each seat belt system.
5. Get your teacher's approval, and perform the trials for each of the seat belt designs.
6. Sketch an air bag set-up.
7. Repeat Steps 4 and 5 for the air bag set-up.

Evaluate

1. In which collision was the passenger damaged the most? Describe the injuries.
2. In which collision was the passenger damaged the least? Describe the injuries.
3. Which seat belt design caused the least injuries?
4. How well did the air bag work compared to the seat belt?
5. Draw a safety system for a real car. Explain why you think this system would work.

SCIENCE Myths

Many people believe it is safer to be thrown free in a collision. They do not want to wear a seat belt because they worry about being unable to get out if the car catches fire or sinks in water.

In fact, less than one in 200 accidents involves a burning or submerged vehicle. Conscious victims are often able to undo their seat belts and escape.

Safe Roads

Roads are designed to be as safe as possible. Most neighbourhood roadways have the safety features shown here.

Figure 13.11 Rumble strips remind people to slow down before intersections or in school zones.

Figure 13.12 Guardrails may protect cars from falling over steep edges.

Figure 13.13 Flashing yellow lights warn of pedestrian walkways or upcoming intersections.

Figure 13.14 Breakaway light poles can fall apart on impact to reduce the force of a collision.

READING Check

List three safety devices used on roadways to reduce the impact if struck by a motor vehicle.

Try This!

What colours are best for signs? What colour should the background be? What colour is best for any lettering? Experiment to find out. How does colour intensity, letter size, and paper quality affect your results?

Check Your Understanding

1. Which vehicle safety feature do you think is the most important? Explain your answer, using statistics or evidence if possible.
2. Name two forms of maintenance that should be performed frequently on your vehicle. Why are these important?
3. What safety features are built into roads?
4. Read the Did You Know? on page 245. How could you stop a vehicle if the brakes suddenly failed?

Key Terms

maintenance

CHAPTER

13 Review

Key Terms

statistics
reaction time
distraction
stimulant
impaired
depressant
BAC
drink
impaired driving
trauma
whiplash
grief
therapy
maintenance

Reviewing Key Terms

If you need to review, the section numbers show where these terms were introduced.

1. Almost everyone has a story about an automobile accident. Write a brief story, real or made-up, using five of the Chapter Key Terms. Underline each term as you use it, and show in parentheses where these terms were introduced (that is, 13.1, 13.2, and so on).

2. In your notebook, match each clue in Column A with a key term in Column B.

A	B
(a) blood alcohol concentration	i. statistics (13.1)
(b) unable to function as quickly as normal	ii. reaction time (13.2)
(c) treatment for emotional and physical injuries	iii. distraction (13.2)
(d) 150 mL of wine	iv. stimulant (13.2)
(e) taking care of your vehicle so it is safe	v. impaired (13.2)
(f) slowed reactions caused by alcohol	vi. depressant (13.2)
(g) injury common in rear-end collisions	vii. BAC (13.2)
(h) provides short-term awake feeling	viii. drink (13.2)
(i) emotions felt after collision	ix. impaired driving (13.2)
(j) something that interests you while driving	x. trauma (13.3)
	xi. whiplash (13.3)
	xii. grief (13.3)
	xiii. therapy (13.3)
	xiv. maintenance (13.4)

Understanding Key Ideas

Section numbers are provided if you need to review.

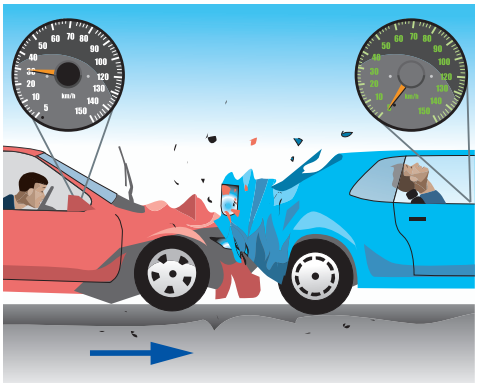
3. What are some common injuries associated with car collisions? (13.3)

4. What do you think is the most important safety feature of automobiles? (13.4)

5. Explain why talking on a cellular phone causes a delayed reaction. (13.2)

Developing Skills

Study this figure to answer questions 6 and 7.

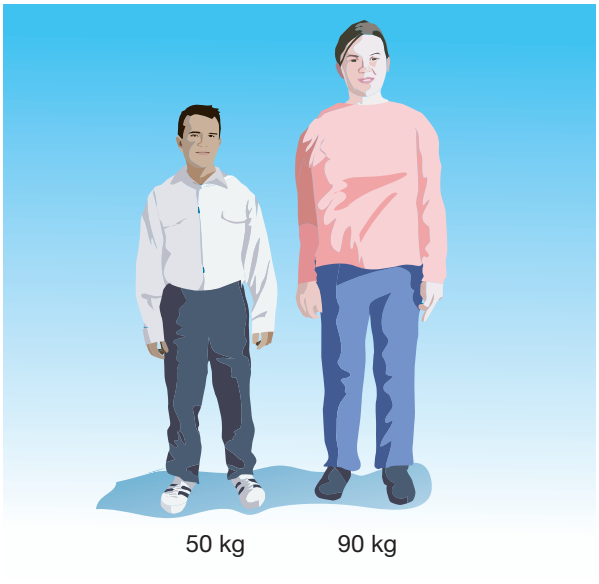


6. (a) Which occupant is more likely to experience whiplash after this collision? (13.3)
(b) What injuries might the driver of the other car receive? (13.3)

7. (a) Which driver is most likely to have fewer injuries? (13.4)
(b) Explain how each driver is protected from injury. (13.4)

Problem Solving/Applying

8. The two people in the drawing shown here each have three drinks in three hours, one drink per hour. (13.2)
- **(a)** Explain who would likely show more impairment.
- **(b)** Would it be possible for the other person to be more impaired? If so, how or why?
- **(c)** Will one or both be over the legal limit? Explain.



9. A 90 kg male who has four drinks will have a BAC level of 0.087. Calculate how long he will have to wait after his last drink until he can legally drive. Show your thinking and calculations.

10. A 65 kg female who has five drinks will have a BAC level of 0.146. How long after her last drink can she legally drive? Show your thinking and calculations.

Critical Thinking

11. Should individuals be allowed to decide whether or not they use a seat belt? Argue your opinion in a few brief points. (13.4)

12. Should drinking and driving laws be changed? How would you adjust the current laws to be as fair as possible? (13.2)

13. Proper vehicle maintenance is a responsibility of all drivers. How could maintenance problems with a vehicle cause a collision? (13.4)

14.
- **(a)** Do you think cars should have a different kind of seat belt than they have now? Explain your thinking. (13.4)
- **(b)** In your opinion, why have automobile makers stayed with the regular shoulder restraint?

15. Use a labelled diagram to explain how a driver following too closely behind another car has less reaction time than a driver who has left at least a three-second gap. (13.2)

Pause & Reflect

1. Do you think campaigns against drunk driving are effective? How might you design a better campaign? What could you include to make a person who is considering drinking and driving reconsider?
2. Check your original answers to the Getting Ready questions on page 232. Based on what you now know from the statistics you have studied in this chapter, were your answers correct? How have your thoughts about driving changed now that you have studied this chapter?